Is Corn Earworm the Next Field Crop Pest for Ontario?

Tracey Baute, Field Crop Entomologist, OMAFRA

It is August when this article is being written so we do not know what potential impact corn earworm (CEW) could have on our grain corn crop until harvest. Corn earworm was found in several fields in Ontario and Eastern Canada in late summer of 2018 and in 2019. They arrived in Ontario in June which is much earlier than usual and could be a sign of things to come. Corn earworm historically overwinters in the southern US and migrates as moths to Ontario via storm fronts. We usually don’t see moths here until late July or early August. They can on occasion overwinter as far north as the 40th parallel, depending on how mild the winter is. Field research has not been done recently to confirm just how far north CEW are overwintering and emerging. Models indicate that as climate change results in frequent milder winters further north, their overwintering area could expand to the Great Lakes region (Figure 1). What could also contribute to later season infestations in Eastern Canada is that corn earworm also migrate in the fall back to their southern overwintering areas. The last generation to leave locations north and east of here could land back into Ontario in the fall, on route to their more southern destinations.

Figure 1. The number of suitable years (maximum of 24) for potential overwintering of corn earworm in the 21st century, based on global warming models and pest temperature requirements. Source: Diffenbaugh et al 2008.
Corn earworm (*Helicoverpa zea*) has over 100 plant hosts and therefore has many common names, including tomato fruitworm and American cotton bollworm. It feeds on all corn types but especially sweet corn, as well as sorghum, cotton, tomatoes, peppers, most bean types including green, snap, dry beans and soybeans, alfalfa and many others. They prefer to feed on the fruit or reproductive part of the plant. In corn, they feed on the silks of the ear and kernels. In beans, they mine into the pods and feed on the seeds inside.

Adult moths are sandy, tan or reddish brown in colour with a central brown dot on the forewing and lighter coloured hind wings with dark brown borders (Figure 2). Female moths lay single eggs, in the case of corn, on individual sink hairs, making them very difficult to see. The larvae vary greatly in colour from light green, yellow, pink, brown to almost black. All have a light orange head and older larvae have prominent stripes along their body. All CEW larvae have dark tubercles (warts) running the length of the body with coarse hairs sticking out of some of the “warts” (Figure 3). It is easier to tell if you have corn earworm because of the variation in colour. If there is a green larva in one plant but a brown one or pink one in the next plant, all of which have warts and hairs sticking out of them, then it is likely CEW.

Thresholds and management vary depending on the crop. In Ontario, sweet corn tends to be its first choice, but that might be changing. If moths continue to arrive earlier, other crops can be more attractive early on. Moths prefer to lay eggs in corn fields during tasseling where there are fresh silks to place their eggs on. Their earlier arrival this year made tomatoes the first crop to go to in June. With field corn planting so delayed, moths were equally attracted to sweet and field corn that were tasseling at the same time. Last year, we found larvae in late August, early September in grain corn which means they were likely still laying eggs after silks were brown in these fields. We may also see them in the dry bean crop this year.

So why be concerned about corn earworm? There are a few important reasons:

1) It is difficult to scout for unless you use traps to monitor for their presence. The eggs are impossible to see so they can go unnoticed until the larvae are feeding.

2) Spray timing could be difficult, especially in crops where only one application is economical. High value crops like sweet corn have weekly spray programs to keep CEW out. Timing is so important because they are difficult to control once they are inside the fruit of the plant.

Most important and concerning is 3) Resistance. This pest arrives here from the southern US where there are multiple generations each year. They are known to be resistant to foliar pyrethroid insecticides and because they feed on both cotton and corn, they have developed resistance to almost all of the Bt traits that could control them. There is field evolved resistance to Cry1Ab (event Bt11) and Cry1A.105+Cry2Ab2 (event MON89034) in the US. And there are indications of potential resistance developing to Vip3A which is now heavily used in both cotton and corn in the southern US. These resistant populations are what migrate to Eastern Canada. There have been a number of field calls in Ontario with corn earworm larvae found in SmartStax corn (Cry1A.105+Cry2Ab2). So currently Vip3A is the only trait to provide protection in Ontario, though we don't know how long control by that trait will last. As resistant population become more common and control is less effective, corn earworm populations could be more prevalent in many of its host crops.

There are a few key things we need to start doing in Ontario to keep this pest at bay. Plant host crops as early as possible to be less attractive to the moths when they do arrive. Use pheromone traps to monitor populations so we know when moths arrive and are active in the area. Scout for signs of early feeding and young larvae when control may still be viable. And rotate chemistries used against them. Pyrethroids are no longer an option but using products from other chemical
families and rotating between chemical families for each application reduces resistance. If you plant Vip3A corn and find CEW in the ears, notify your seed agronomist and myself so that we can confirm if resistance has occurred and what measures to take next to mitigate the issue.

References:


Get a Jump on Early Spring Forage
Christine O’Reilly, Forage and Grazing Specialist, OMAFRA

Cereals, soybeans, and silage corn are all being harvested, or will be soon! That bare ground provides an opportunity to boost forage inventories by double cropping with a winter cereal, while getting all the benefits of a cover crop in the rotation.

Why use winter cereals as forage?

1. **It's a cover crop that makes money the year it is grown.** If you have livestock, forage generates the meat or milk that leads to a paycheque. If you don't have livestock, ask some neighbours to see if someone is interested in buying your standing cereal crop. Most cover crop benefits come from the roots, not the top growth, so there's an opportunity to sell the forage without compromising on soil health.

2. **They have higher yield potential than spring cereals.** Provided there is enough forage on hand to feed livestock all winter, this strategy can produce more forage per acre than planting spring cereals in late summer or early fall. Research by Dr. Bill Deen and colleagues shows that oats will yield around 2.3 tonnes of dry matter (DM) per hectare (ha), while fall rye can yield 3.0 tonnes DM/ha.

3. **Winter cereals are ready for forage harvest before the next crop is planted.** The time when forage supplies are tightest is when winter cereals are ready to cut. This provides a home-grown boost to feed inventories when hay prices are strongest.

4. **They are ready to be grazed before perennial pastures.** If the infrastructure is available, grazing winter cereals in the early spring provides a longer rest for perennial pastures. Conventional wisdom says turning livestock out to pasture a day too early in the spring costs three days of grazing in the fall. Maximize your pasture's yield potential by grazing a winter cereal until the perennial grasses have 3-4 fully developed leaves, then switch the livestock over.

Fall rye is the most commonly used winter cereal for forage in Ontario. It is the most winter hardy and the earliest maturing species. Fall rye can be sown after silage corn harvest on well-drained soils. Winter wheat is more palatable than rye, but by the time it reaches flag-leaf to early boot stage, crop options to follow it are limited. Triticale is a hybrid of rye and wheat. It is ready to harvest 7-14 days later than rye. Seed can be difficult to source in Ontario, so it is often the most expensive winter cereal. Winter barley seems to consistently winter kill in southern Ontario and is therefore may not be a good choice for a forage double crop.

How to get the most out of forage winter cereals:

- **Fertilize the crop.** Unlike a cover crop, forages need to be fed to reach their potential. Incorporating manure ahead of planting a winter cereal is a great way to use manure nutrients. Where no manure is available, apply P and K as a starter as per the soil test, and 55 kg N/ha (50 lbs/acre) in the spring at green-up.

- **Use a forage seeding rate.** Cover crop recommendations are often too light to produce good forage crops. Winter cereals should be planted at 110 kg/ha (100 lbs/acre). Seed at 3-4 cm (1.25-1.5 in.) depth to reduce heaving.

- **Plant them early.** Tom Kilcer’s research in New York state suggests that there is a 20-30% increase in forage yield if fall rye and winter triticale are planted 10-14 days before the optimum winter wheat planting date. This gives the
crop plenty of time to tiller in the fall. More tillers generate more stems, and provide a higher forage yield overall. If double-cropping winter cereals for forage is going to be a staple in the crop rotation, producers should consider a shorter season silage corn or soybean to enable timely planting of the cereal.

- **Harvest at flag-leaf to boot stage for maximum feed value.** Digestible fibre and crude protein contents are highest before the crop starts to head out. Nutritional quality declines quickly once the heads emerge, through triticale seems to retain quality a little better than rye. This early harvest window enables timely planting of the following crop.

In situations where there is enough forage available for winter feeding, winter cereals can be a great way to boost forage inventories in the spring. They yield higher than fall-planted spring cereals, are ready to harvest earlier in the spring than any other forage and provide all the benefits of a cover crop.

**Sources:**


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**Diagnosing Nutrient Deficiencies**

**Jake Munroe, Soil Fertility Specialist, OMAFRA**

Nutrient deficiencies can seriously impact crop yield. Certain deficiencies are seen every year in Ontario field crops, such as nitrogen deficiency in corn and manganese deficiency in soybeans. Others are brought on or made worse by environmental conditions – for example, potassium deficiency in soybeans and boron deficiency in alfalfa (Figure 1) during dry spells.

Knowing how to identify deficiencies enables you to take corrective action, immediately, if possible, or in the following season. At this year’s Southwest and Eastern Crop Diagnostic Days, my horticulture counterpart, Christoph Kessel, and I presented on how to diagnose crop nutrient deficiencies.

As we shared, there are two key observations that you must make: first, what type of symptom are you seeing, and second, where on the plant are you seeing it?

Chlorosis is yellow or pale green tissue. It indicates that chlorophyll production is being negatively affected. Chlorosis can occur over the whole leaf or it can affect the leaves while the veins remain green – this is called interveinal chlorosis (Figure 2). Chlorosis is associated with deficiencies of nutrients that play important roles in chlorophyll production, such as nitrogen, magnesium, sulphur and iron.

Necrosis, or tissue death, can occur as the deficiency becomes more severe – think of lower corn leaves “firing up” and dying (Figure 3). Necrosis is often the result of nitrogen, potassium or magnesium deficiency.

Certain deficiencies cause abnormal growth. In these cases, the lacking nutrient plays a crucial role in cell replication and elongation. An example is boron deficiency in sugar beets, which causes crinkled and deformed leaves.

Next, where you see symptoms on the plant matters. Nutrients that are mobile within the plant will show up on the older, lower leaves.

**Figure 1.** Boron deficiency in alfalfa, as indicated by yellow-reddish younger leaves and shortened internodes. Tends to occur more often in coarse, low organic matter soils during dry conditions.
These include nitrogen, phosphorus, potassium and magnesium. Immobile nutrients that cannot easily be moved within the plant show deficiency symptoms mainly on the newer, upper leaves. These include boron, sulfur and manganese, to name a few. Finally, there are several nutrients that have intermediate plant mobility and can show up as deficiencies on younger and older growth. Zinc deficiency in corn is an example of this.

There are characteristic deficiency symptoms for certain nutrients. For example, nitrogen and potassium deficiency both cause chlorosis on the lower leaves of corn, but potassium affects the leaf margins, while a lack of nitrogen causes a V-shaped yellowing from leaf tip to midrib.

Symptoms may also show up uniquely on specific crops. Manganese deficiency shows up as interveinal chlorosis in soybeans but causes grey tissue in cereals. Potassium deficiency causes white or yellow spots along leaf margins in alfalfa and clover, instead of the straight yellowing of leaf margins seen in corn and soybeans (Figure 4).

Keep in mind that what looks like a nutrient deficiency may not always be caused by a lack of available nutrients. For example, soybean cyst nematode damage can cause potassium deficiency symptoms due to root damage, even when enough potassium is available in the soil. Phosphorus deficiency can also be the result of poor planting conditions and restricted early season root growth. Certain diseases and insect pests may also cause damage that resembles nutrient deficiencies – be sure to consider all possibilities.

OMAFRA has a key that you can use to help identify nutrient deficiencies based on unique symptoms and where they present themselves on the plant. Find it under the Soil Fertility page of our Field Crop News website. If you see plants that don’t look quite right in your fields, take a closer look and see if a nutrient deficiency might be the cause.
As we saw with the 2019 winter wheat crop, if winter wheat is planted late and if conditions are not fit, there is a greater risk of winter survival issues. Seeding depth, plant population and the use of a starter fertilizer are also significant factors that need special attention at planting.

When it comes to determining your optimum planting date for your region, Ontario’s Optimum Winter Wheat Planting Date map (Figure 1) is a great resource. When determining the optimum date, find your location on the map and look at the dates on the lines on either side of you. The planting date range for that region falls between those two dates. The closer you are to one line means the optimum planting date is closer to that end of the range. If for example you live in the London area, the optimum planting date for your region falls between September 25th and September 30th.

Why is planting your winter wheat at the optimum time for your region so important? Well, it is important because it takes approximately 80 Growing Degree Days (GDDs) for winter wheat seed to germinate and another 50 GDDs for wheat to emerge for every inch of seeding depth. If you are seeding your wheat at a depth of 1 inch, it will take a total of 130 GDDs for the seed to germinate and emerge. If you plant deeper, it will take more GDDs for those plants to emerge. The later we plant wheat, the less GDDs we get and the less advanced your wheat will be before winter. While we may get away with pushing our planting dates later some years, there is a risk of running into cool conditions earlier than anticipated. This can result in significantly less GDDs and less growth in your winter wheat crop before winter.

Figure 1: Updated Optimum Planting Date Map for Winter Wheat in Ontario.
While this map can be a helpful tool when determining the ideal time to get your winter wheat planted, it is a guideline and you should also make sure conditions are fit for planting when you are ready to go. If the conditions aren’t right and waiting a day or two beyond the optimum date means better planting conditions, then wait for the better planting conditions.

While it may come as a surprise, you can plant winter wheat too early due to the increased risk of snow mould, lodging and Barley Yellow Dwarf Virus (BYDV). It is generally not recommended to seed more than 10 days prior to the optimum date for your region. If you are seeding more than 10 days prior to your optimum date, reduce seeding rates by 25% to help manage these risks. If you are planting later than the optimum date, the seeding rate should be increased by 200,000 seeds/acre per week to a maximum of 2.2 million seeds/acre to compensate for the delayed planting.

It is also important to pay special attention to your seeding depth. Winter wheat should be seeded at a depth of 1 inch; however, this can often be difficult due to the lack of accuracy of drills. Therefore, you should target 1.25-1.5 inches to ensure you are seeding your wheat deep enough. Shallow seeding can result in plants being more prone to winterkill and heaving.

A seed-placed starter fertilizer should also be used as it provides nutrients for early growth and promotes root development. As a result, we see an improvement in winter survival and crop uniformity which helps with disease management the following spring.

A coloured version of the planting date map is also available. Both versions can be found on www.GoCereals.ca under the downloads section of the “Resources” page.

Using the 3R’s to Advance the 4R’s
Christine Brown, Sustainability Specialist – Field Crops, OMAFRA

In much of Europe there have been restrictions to applying manure only during the growing season. There the technology has been perfected over time to meet those needs. Wouldn’t it be fitting to bring the technology to Ontario without the same application restrictions? I asked a few custom applicators what was holding them back from utilizing the European technology in Ontario. Their response may surprise you.

Application equipment in Europe is being fine-tuned with the potential to monitor phosphorus and nitrogen levels on-the-go and adjust them to meet pre-set requirements. Application booms have been set up to look like sprayer booms with drop hoses spread at intervals similar to sprayer nozzles on 10 inch (25 cm) spacings. They have been designed to allow manure application to occur in several different crop scenarios. This equipment in Ontario would have opportunities from early spring application onto wheat crops; or to forage crops post-harvest; to side-dress application into standing corn and even to edible bean and canola crops before or after planting. Post wheat harvest, application can occur with cover crops, including “laying down” the manure under the crop canopy for red clover stands. Narrow spacing allows greater uniformity and placement where the roots can access the manure more quickly. Manure flows through the multiple small hoses with the help of a series of macerators, capable of chopping manure solids and preventing plug-ups and time-consuming clean-outs.

Figure 1. Manure flows through the multiple small hoses with the help of a series of macerators, capable of chopping manure solids and preventing plug-ups and time-consuming clean-outs.
Increased precision in manure application seems like a logical investment for custom applicators. The increased options for spreading out the manure application season into the summer months would help balance the cost of the technology.

However, according to some applicators, the barrier to advancing this technology into Ontario is the garbage or debris that is in many manure storages. “Everything gets thrown into the pit as if it was a garbage can” according to one applicator. From latex gloves to insemination tubes to cow hoof blocks to fast-food coffee cups and other garbage, etc., these are the items that the macerators can’t consistently chop and ends up plugging the tubes. Custom applicators aren’t willing to update to this type of equipment because it is expensive, and the fear of time and labour associated with plug-ups and clean-outs is just too risky.

Plastics contamination of some municipal waste have been a barrier to using some of these products on farm fields. But sadly, it is also an issue in the manure storages on many farms. So, in this era of one-time use plastics and waste that Canadians are slowly transitioning away from, is it time to train employees, farm staff and visitors doing work in barns to use garbage containers? Containers for plastic and glass waste should be in every barn. Signage reminding everyone not to litter: that the manure storage is the farm’s fertilizer and organic matter source, may help with changing attitudes around waste disposal. Screens around the manure agitation/pump system are an option where removal of contaminants is impossible.

It’s time to use the 3-Rs (Reduce, Re-Use, Re-cycle) to help to advance the 4R’s (Right source, Right time, Right place, Right rate) of manure nutrient stewardship.

**How Much More Time Will My Late Planted Corn Need to Reach Maturity?**
*Ben Rosser, Corn Specialist, OMAFRA*

This is a tough question to answer. Naturally one would want to look at their current growth stage, add CHUs required for successive growth stages until maturity, and calculate which calendar date this would place them at based on average long-term CHU accumulations. The trouble with this approach is that corn plants adapt to later planting by shortening thermal time (or number of CHUs) to progress through each growth stage, so the CHUs required to progress through growth stages for corn planted June 1 is less than the number of CHUs required to progress through the same growth stages for the same hybrid planted May 1.

An excellent research paper investigating the impact of plant development and time to maturity from delayed planting was written by Nielsen et al (2002) who evaluated the impact of delaying planting of select hybrids from end of April to early June in Indiana and Ohio during the early 1990’s.

Some key conclusions from their research:

- Hybrids appear to have some ability to adapt to shorter season environments. As air temperatures decline, so do their growing degree day (GDD) requirements to progress through each growth stage. This is part of the reason why hybrid switch dates and suggested switch CHU ratings do not just simply track declines in average CHU as planting is delayed.

- Silking (R1) and black layer (R6) occurred in fewer calendar days for June planted corn than early May planted corn. Vegetative stages required 10 fewer days, though reproductive stages required 5 additional days. Overall, June planted corn matured 5 calendar days quicker than early May corn.

- While days for emergence declined with planting delay (consistent with warming soil temperatures), GDD for emergence was similar for all planting dates.

- Silking (R1) and black layer (R6) required fewer GDD for June planted corn than early May planted corn (34 and 144 GDD less, respectively), a 10% reduction overall. While the greatest reductions occur during reproductive stages, reproductive stages still take more days to complete as they occur later in the year during days with lower GDD accumulation.

- Within a location, later maturing hybrids see greater reductions in GDD requirements for delayed planting than earlier maturing hybrids. These reductions strengthen as planting is delayed.
While reductions in GDD required to complete reproductive stages of delayed planting may be partially influenced by greater probability of frost events causing premature black layer, reductions were still evident in trials where no killing frost occurred prior to black layer.

So Practically, What Does This Mean?

If you planted a hybrid in early June you would normally plant in early May, you can expect it to mature in fewer CHU and calendar days than normal. If you are estimating days to maturity from silking, early June planted corn still requires fewer CHU than early May planted corn, but development is pushed to days with lower CHU accumulation, so will likely take more calendar days than you would expect from May planted corn. Nielsen et al (2002) observed average time from silking to black layer increase from 63 days for early May planted corn to 68 days for the same hybrids planted early June.

See the complete version of this article at FieldCropNews.com

References:


Same Manure Pile, New Platform

Christine Brown, Sustainability Specialist – Field Crops, OMAFRA

Introducing…..to your mobile device or computer, the first of several on-line AgriSuite calculators that will help with agronomic and environmental land use decisions.

The nutrient management software (commonly known as AgriSuite, which includes NMAN and MSTOR) has been available to Ontario Farmers for many years. Although popular, it is perceived to be mainly a regulatory tool and perceived to be too complicated, therefore it was time to modernize the software to incorporate individual stand-alone tools that are more compatible with industry needs and processes.

Give it a try today at: Ontario.ca/agrisuite

The first tool recently released is called the Crop Nutrient Calculator and calculates crop nutrient needs. When soil test, location, planned crop and yield goal are provided, the crop nutrient needs and nutrient removal information is displayed. The information provided is based on Ontario data and includes the nitrogen calculator for corn crops. The information can be saved and printed by the user. Information is not accessible to anyone beyond those selected by the user.

Coming soon are other calculators that will help with nutrient management decision making. They include:

- Organic Amendment Calculator and Fertilizer Calculator
- Assessing risk of phosphorus and nitrogen loss (PLATO calculator)
- Determining manure storage sizing and manure volumes produced (MSTOR calculator)
- Calculating minimum distance separation (MDS calculator)
- Estimating greenhouse gas emissions (Greenhouse Gas Calculator)

AgriSuite is being rebuilt with funding from the Canadian Agricultural Partnership. The AgriSuite team welcomes comments, questions and suggestions.

The next tool, the Organic Amendment Calculator will help determine fertilizer and manure inputs and is planned for release in early winter. Imagine being able to determine what the N-P-K value and economic value of your manure is and what micro nutrients are being supplied to the soil with each application. The tool will provide similar information to the current software, but in a simpler process. When manure analysis information is provided along with management decisions around timing, placement and rate the tool will provide estimates for available nutrients and potential economic value. For example, a layer poultry manure analysis including micro nutrients, C:N ratio and organic matter at a rate of 5 ton/ac in early fall and incorporated within 24 hours would provide approximately 75 lbs/ac of nitrogen, 290 lbs/ac of P₂O₅ (full value) and 250 lbs/ac of K₂O. Where soil test levels are already high, the immediate value for manure is lower. In addition, 3.3 lbs/ac zinc, 50 lb/ac magnesium, 3.5 lb/ac manganese and 60 lbs/ac sulphur would be supplied. Economic value for the available N-P-K after application cost ($4/ac) is deducted would be approximately $325/ac or $65/ton. There is additional value provided by the organic matter (2,400 lbs/ac) and the value of the micronutrients (e.g., $37/ac value from sulphur).
The Fertilizer Calculator is also planned for early winter release and will help determine the nutrients needed for a crop before or after manure nutrients are tallied and will provide common fertilizer blends that could match those needs.

**Figure 1:** Screen shot of example scenario using Crop Nutrient Needs Calculator